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RESEARCH ARTICLE

Of people and toads: Local knowledge about amphibians around a protected area in the Brazilian Atlantic Forest

Sobre gente e sapos: conhecimento local sobre anfíbios dos arredores de uma unidade de conservação na Mata Atlântica brasileira

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Abstract

This study aimed to identify ethnozoological knowledge about amphibians of people living around a protected area, the Wildlife Refuge of Una (REVIS), located in the Atlantic Forest, in southern Bahia, Brazil. Semi-structured interviews were performed on a random sample of residents right outside the REVIS limits. Photos of several amphibians that live in the REVIS were also shown for recognition of the regional species. We analysed the use value (VU) of each species, calculating the ratio between the number of times that each species was mentioned and the total number of interviews.

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Biophilic relationships, using Kellert´s (1993) classification, were inferred from their statements. We interviewed 40 individuals (22 males and 18 females) with ages between 10 and 82 years. There was a gender-related bias regarding the recognised species (Chi Sq = 0.013, $p < 0.05$) with men having more knowledge than women. The Butter Frog, *Leptodactylus latrans*, had the highest VU of 0.73 and was the most mentioned overall, but especially amongst women. The most mentioned species amongst men was Burmeister's Frog (*Phyllomedusa burmeisteri*). We identified 18 biophilic comments, classified as moralistic, symbolic, negativistic or utilitarian. It was possible to note that, in this community, the knowledge and use of amphibians is not deep, purely cognitive and without any direct utilitarian purpose (medicine or cooking, for example). This study can build a bridge between traditional anurofauna knowledge of the Una region and modern environmental education, by demystifying existing information and incorporating it in local conservation actions, becoming especially relevant in rural areas, such as this protected area.

Resumo

O objetivo desta pesquisa foi identificar conhecimento etnozoológico acerca dos anfíbios dos moradores das vizinhanças de uma unidade de conservação, o Refúgio de Vida Silvestre (REVIS) de Una, situada em área de Floresta Atlântica, no sul da Bahia, Brasil. Foram realizadas entrevistas semi-estruturadas a um grupo aleatório de residentes nas imediações do REVIS. Foram mostradas imagens correspondentes aos anfíbios que habitam no REVIS para reconhecimento. Foi calculado o Valor de Uso (VU) para cada espécie dividindo o número de vezes que uma espécie foi mencionada pela quantidade total de entrevistas. A partir das declarações nas entrevistas, foram inferidas as relações biofílicas segundo Kellert (1993). Foram entrevistadas 40 pessoas (22 homens e 18 mulheres) com idades entre 10 e 82 anos. Houve um viés de gênero nas respostas (Chi Sq = 0.013, $p < 0.05$), com os homens detendo mais conhecimento que as mulheres. A rã manteiga, *Leptodactylus latrans*, obteve o maior VU (0.73), tendo sido a mais mencionada, especialmente pelas mulheres. A espécie mais mencionada pelos homens foi a rã-de-Burmeister, (*Phyllomedusa burmeisteri*). Identificamos 18 comentários biofílicos, classificados como moralísticos, utilitários, moralísticos e negativísticos. O conhecimento sobre os anuros não é aprofundado, tem caráter cognitivo e não possui uma relação utilitária direta (como alimentação ou remédio, por exemplo). Este estudo pode diminuir a brecha entre o conhecimento tradicional e a educação formal ocidental, o que se torna especialmente relevante em regiões rurais como a dessa unidade de conservação.

Keywords

Anura, ethnozoology, local ecological knowledge

Palavras-chave

anurofauna, etnozoologia, conhecimento ecológico local

Introduction

Ethnobiology is an interdisciplinary field that studies the knowledge of human populations about the processes of nature (Diegues 2000). It seeks to understand how natural resources are perceived, classified and used by people, which classification systems are used by certain cultures and which processes determine them (Begossi et al. 2004).Communities outside urban areas create a dynamic body of knowledge on the animals and plants they encounter daily and this information is useful for

their survival and well-being. Most of this information is orally transmitted and subject to specific feelings, customs, practices and beliefs (Marques 2001). When communities are engaged with resource-use over time, this knowledge becomes part of what defines them as a cultural group and can be described as Traditional Ecological Knowledge (TEK). This wisdom evolves as people build on their experiences and observations, experiment, interact with other knowledge systems and adapt to changing environmental conditions over time (Berkes et al. 2000). However, since it is difficult to assess TEK, we subscribe to the concept of Local Ecological Knowledge (LEK), as being the information, practices and beliefs on ecological relationships that are gathered by members of a community through observations and experiences that could eventually become TEK (Charnley et al. 2008). The way humans see and classify their surroundings and eventually interact with them, leading to economical exploitation, seem to have a common ground for all societies and cultures (Berlin 1992). Obviously, there will be a variety of specific classifications, names or complexities, but things, such as inclusive categories and hierarchies, seem to be a background form of grouping similar things and are something in common between folk and scientific taxonomies and systematics (Berlin 1973). This is how Berlinean classification emerges, common in many ethnobiological approaches although scarcely explored by mainstream science, by classifying living organisms using inclusive categories defined by LEK.

It is widely accepted that traditional and local ecological knowledge provide valuable input for resource management and conservation (Berkes et al. 2000), being a source of important data for policy-makers and researchers (Braga and Schiavetti 2013). Local communities inside protected areas, policy-makers and managers must equally understand the relevance of the taxonomic groups they live with, in order to preserve both habitats and their biodiversity (Alves 2012). This involves a fusion between LEK and what could be called "western scientific knowledge". We do not wish to create a false dichotomy, since these concepts are not opposites, but it is true that, although both are valuable sources of information, they have different core origins. "Western scientific knowledge" usually tests hypotheses and is generated using the scientific method. Traditional and local ecological knowledge usually have a utilitarian nature and are generated through practical experiences (Ellen and Harris 2000; Charnley et al. 2008).

Amphibians have been widely used as indicators of local diversity, especially in areas like the Brazilian Atlantic forest, considered one of the world's biodiversity hotspots (Mittermeier et al. 2005), with approximately 7% remaining from its original area (Ribeiro et al. 2009). Brazil has 1026 described amphibians, with most of the endangered species living in this ecosystem (Frost 2019). From these, 543 are endemic to the Atlantic Forest (Haddad et al. 2013). The main threats are anthropogenic-derived habitat destruction, conversion into agricultural areas and urbanisation (Campos et al. 2014).

Most of the remaining Atlantic Forest exists in small fragments (< 100 ha), isolated from each other and composed by second-growth forests in early to me-

dium stages of succession (Ribeiro et al. 2009). In southern Bahia, the current landscape is a mosaic composed mainly of small forest fragments immersed in a matrix of shaded cocoa plantations, called "cabrucas" (Gouvêa et al. 1976; Sambuichi et al. 2012).The Atlantic Forest of southern Bahia is highly biodiverse and has several records of endemic species. Many taxa have been described in the last 10 years, including amphibians (e.g. Recoder et al. 2010; Lourenço-de-Moraes et al. 2012; Vörös et al. 2017; Lourenço-de-Moraes et al. 2018), plants (e.g. Aona et al. 2016) and invertebrates with special public health interest, such as Diptera (e.g. Catenacci et al. 2017).

As a hotspot, the Atlantic Forest depends heavily on protected areas for its survival as an ecosystem (Tabarelli et al. 2005). A Wildlife Refuge (REVIS, in Portuguese) is a type of protected area defined in the Brazilian legislation, which allows only indirect uses of all natural resources within their established perimeter. The region of Una, in coastal southern Bahia, has three other protected areas, with different levels of protection: the National Park Serra das Lontras, the Biological Reserve of Una, for which the REVIS acts as a buffer zone and the Marine Extractive Reserve of Canavieiras (Solberg et al. 2014; Castilho et al. 2017; Cardozo et al. 2018; Castilho et al. 2018). The REVIS of Una concentrates a major part of the amphibians from southern Bahia. There are not many inventory studies in the area, however the most found amphibians would be *Leptodactylus latrans*, *Boana faber*, *Stereocyclops incrassatus*, *Pipa carvalhoi*, *Physalaemus camacan*, *Dendropsophus elegans*, *Phyllodytes melanomystax*, *Haddadus binotatus*, *Rhinella hoogmoedi* and *Rhinella granulosa* (Aguiar et al. 2003; Silvano and Pimenta 2003; Dias et al. 2014). Most of them are in the status of "least concern" in the IUCN Red List (IUCN 2019). An important case would be that of *Allobates olfersioides*, registered as "data deficient", but considered vulnerable because of its alarmingly decreasing population numbers.

Herpetofauna, in general, is mostly rejected by society, being associated with negative reactions of disgust and fear because of myths, legends and beliefs that are transmitted from generation to generation (Ceríaco 2012). Much of the population has a misconception regarding these organisms and, as a result, many of them are killed or mutilated.

A new approach to the management of natural resources includes informing and empowering local communities, who become decision-makers, along with governmental and non-governmental institutions. This strategy is based on valuing social and cultural incentives beyond financial activities and accepting the contribution of folk knowledge to natural resource management and, ultimately, to science as a whole (Berkes 2004; Horwich and Lyon 2007).

Wildlife is used for a variety of purposes, such as cooking, medicinal and recreational (Chakravorty et al. 2011). Amphibians are, on one hand, commonly regarded as distasteful animals (Ceríaco 2012). On the other hand, their ecological relevance is often acknowledged (Gardner et al. 2007; Campos et al. 2013, 2014). In this study, we aim to describe the ethnobiological relationships of a community living within a protected area with the amphibians that surround them: what are their princi-

ples and values regarding amphibians? Are there any ethnobiological uses, such as medicinal or religious? Are there any links to myths or beliefs? By assessing the local ecological knowledge on this often threatened taxonomical group, we intend to glimpse a phenomenological construction of their world view and insert it into more efficient management plans for this protected area.

Materials and methods

Study area

The Wildlife Refuge (REVIS) of Una was established by a Federal Act in 2007 and has an area of 23404 ha. The area is located in southern Bahia, in the county of Una, with a small portion entering the county of Ilhéus, in north-eastern Brazil. (Figure 1). Current estimated population is around 24 thousand people, with a human density of 20.48 inhabitants/km^2.

Traditional dwellers include people of Tupinambá ethnicity, combined with some of the first Portuguese and African descent people arriving to Brazil. The first Portuguese people arrived at an area 200 km south of Una; Salvador, capital of the state of Bahia, was the first and most important African slave port of entry (Walker 2007). Agriculture, the main regional commodity, is mostly cacao, with sparse plantations of rubber and african palm (*Elaeis guineensis*) (Walker 2007; IBGE 2010).

The county of Una is part of the cacao region of southern Bahia. This area has been historically linked to cacao exportation, which brought an exceptional economic growth to this region, especially in the 20th century, until the 80s (Menezes and Carmo-Neto 1993; Johns 1999).

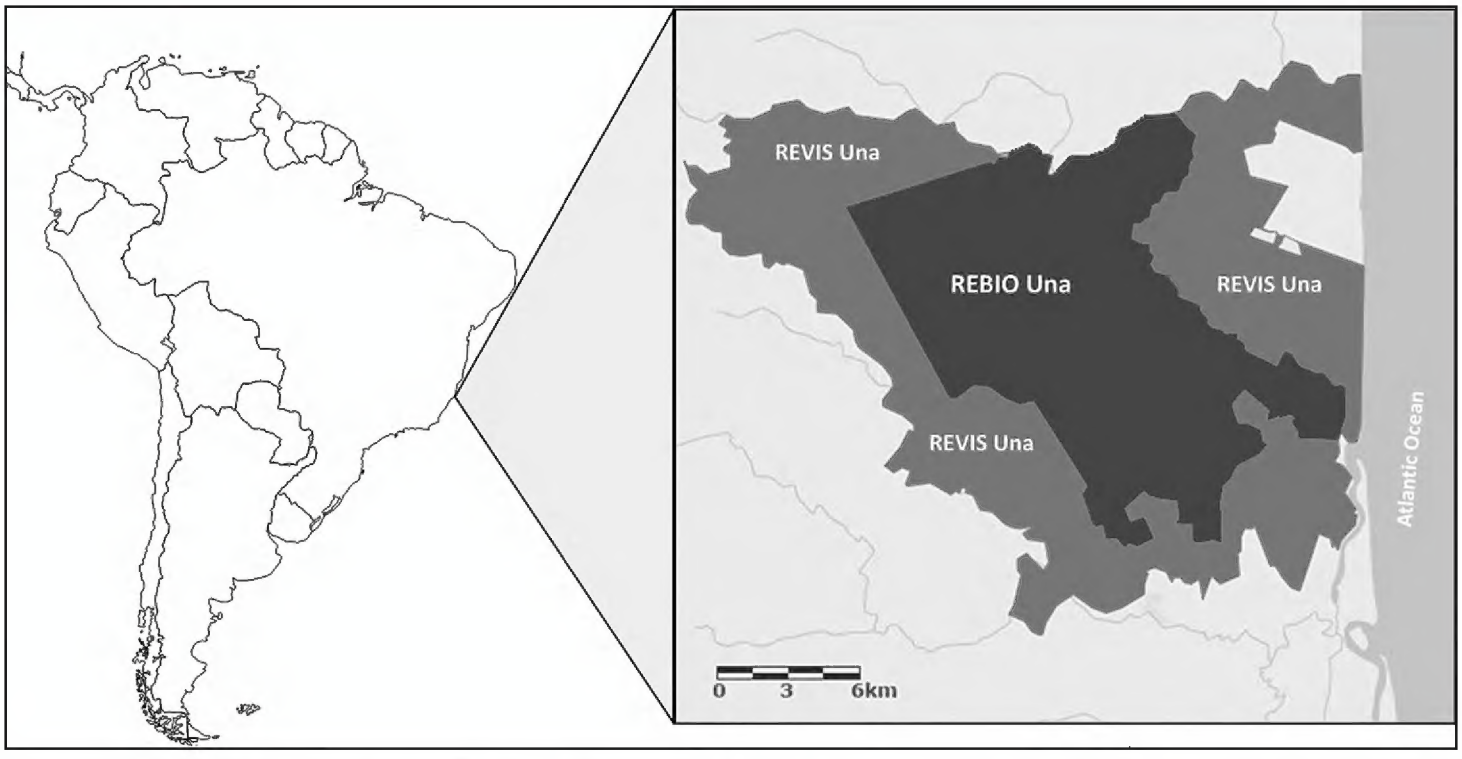

Figure 1. Map of the study area, highlighting the different protected zones around the REVIS-UNA, north-eastern Brazil.

Ethnozoological data collection

Data was collected from owners or residents of 34 out of the 290 properties within the REVIS (mapped by the local manager (ICMBio 2014). Interviews (20–30 minutes long) were conducted in their houses or near them, from January to June 2011. The main researcher (KS) headed the interviews, with occasional presence and help from other researchers working in parallel projects. Properties were randomly chosen out of a grid divided into three strata: neighbouring the REBIO, close to it or far away, according to their distance to the Una Biosphere Reserve (REBIO-Una). Geographical coordinates of the interview location and the property it represented were marked with a GPS at the time of each interview.

A script, composed of closed and open questions, was used to standardise the interview process. However, the order of each question was decided each time, according to the flow of the conversation or the reactions of the interviewees (Dencker 1998). During field trips, the main researcher (KS) kept an ethnographic journal of observations and interviews. Both adults and children were interviewed. Photos of amphibians registered for the area (Figure 2), were shown, along with questions about visualisation and use of frogs. This data gathering belongs to a greater project on regional knowledge of management and governance of natural reserves and has authorisation from the local ethics committee derived from this umbrella research.

Data analysis

All data was analysed by pursuing two approaches: a gender-orientated bias in species detection and use and an age-related knowledge (with an associated gender-bias). Gender and age-associated biases were assessed by using a Chi-Square Test. The present study aimed to describe folk knowledge, using the model of total union of Marques (1991), meaning that all available information on the subject was considered without a clear distinction between what was local culture, popular knowledge or western scientific knowledge that could come from the interviewees. It was, up to certain point, analogous to Geertz's "thick description" (Geertz 1973) with the intention of understanding the relationship of the community with their surroundings.

A collector's curve (Garcia and Lobo 2007) was used to determine optimal sample size. We calculated the use value (VU) for the observed species, using a variation of Phillips et al. (1994):

$VU = (\sum U) / n$
VU = Use value of the species
U = number of times the species was mentioned by the interviewee
n = number of interviews

Interviews were transcribed and analysed for discourses pointing towards biophillic categories following Kellert (1993) (Table 1).

Figure 2. Amphibian photo board used during the interviews, for species recognition by the residents of the surroundings of a protected area in the Atlantic Forest, north-eastern Brazil. (1) *Leptodactylus latrans*; (2) *Boana faber*; (3) *Stereocyclops incrassatus*; (4) *Pipa carvalhoi*; (5) *Physalaemus camacan*; (6) *Physalaemus* cf. *camacan*; (7) *Dendropsophus elegans*; (8) *Frostius erythrophthalmus;* (9) *Phyllodytes melanomystax*; (10) *Allobates olfersioides*; (11) *Rhinella granulosa*; (12) *Rhinella hoogmoedi*; (13) *Haddadus binotatus*; (14) *Siphonops* sp.; (15) *Proceratophrys renalis*; (16) *Rhinella crucifer*; (17) *Phyllomedusa burmeisteri.*

Results

We interviewed 40 people of ages between 10 and 82 years, those being 22 males and 18 females. Almost half of the interviewed people (43.8%) have, as a main income, rural/agricultural activities and no form of formal schooling (48.2%), with men slightly above women in this aspect. Most women were of domestic occupation. More species were recognised by men than by women (Chi Sq = 0.013, $p < 0.05$). We cannot relate recognition directly to age, although there is a tendency amongst people older than 40 years old to recognise more species than younger men or women. Amongst men, there is a certain tendency for older men to recognise more species than younger ones. Additionally, species recognised by women differ from those identified by men. A comment made by interviewee N° 15 (woman, 42 years old) contributes to the understanding of this observation: "*Men and older folk know more because they spend more time of the day in the field*". It does not mean that they

Table 1. A typology of biophillic values, according to Kellert (1993).

Term	Definition	Function
Utilitarian	Practical and Material exploration of Nature	Physical sustenance/security
Moralistic	Strong affinity, spiritual, reverence, ethical concern for nature	Order and meaning in life, kinship and affiliation ties
Negativistic	Fear, aversion, alienation	Security, protection, safety
Symbolic	Use of nature for metaphorical expressions	Communication, mental development
Aesthetic	Physical appeal and beauty of nature	Inspiration, harmony, peace, security
Dominionistic	Mastery, physical control, dominance of nature	Mechanical skills, physical prowess, ability to subdue
Naturalistic	Satisfaction from direct experience/contact with nature	Curiosity, outdoor skills, mental/physical development
Humanistic	Strong affection, emotional attachment, love for nature	Group bonding, sharing, cooperation, companionship
Ecologistic-scientific	Systematic study of structure, function and relationship in nature	Knowledge, understanding, observational skills

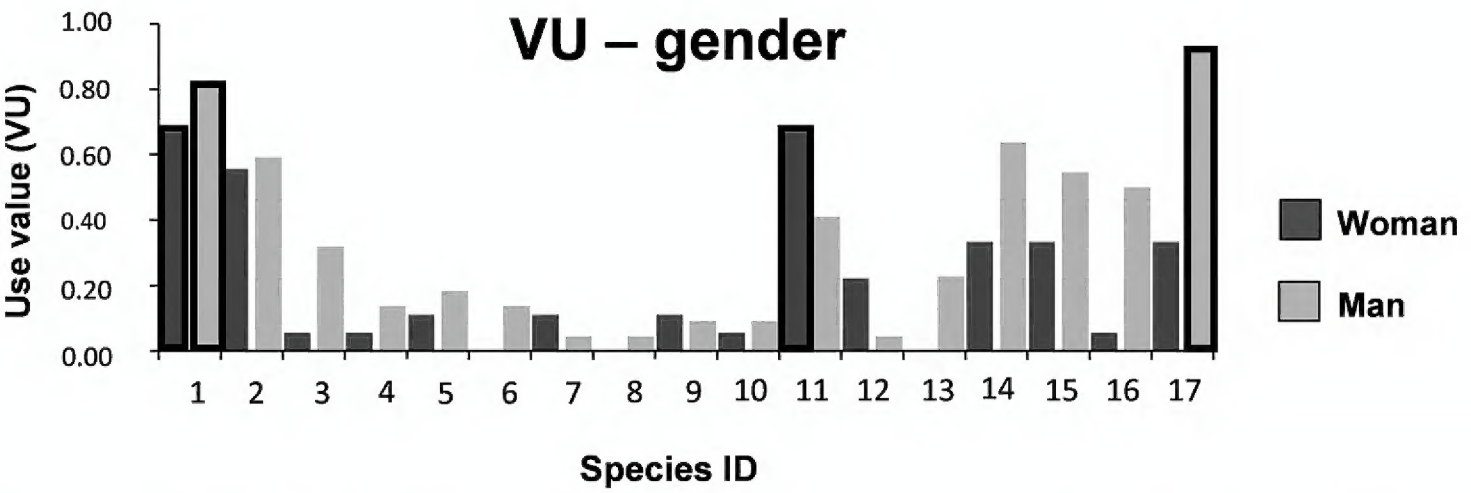

Figure 3. Use value for men and women of all ages, residents in and around a protected area in southern Bahia Atlantic Forest. (1) *Leptodactylus latrans*; (2) *Boana faber*; (3) *Stereocyclops incrassatus*; (4) *Pipa carvalhoi*; (5) *Physalaemus camacan*; (6) *Physalaemus* cf. *camacan*; (7) *Dendropsophus elegans*; (8) *Frostius erythrophthalmus*; (9) *Phyllodytes melanomystax*; (10) *Allobates olfersioides*; (11) *Rhinella granulosa*; (12) *Rhinella hoogmoedi*; (13) *Haddadus binotatus*; (14) *Siphonops* sp.; (15) *Proceratophrys renalis*; (16) *Rhinella crucifer*; (17) *Phyllomedusa burmeisteri*.

"know more", but it is believed that men recognise species inhabiting the area more easily because they spend more time in the field while women stay more frequently within their homes and, thus, are more familiar with species living in areas surrounding their residences (Castilho et al. 2018).

The most commonly observed species overall was *Leptodactylus latrans* with a VU = 0.73. This species was also the most mentioned amongst women (VU = 0.67). The toad *Rhinella granulosa* was the second most mentioned amongst women (VU = 0.66). *Phyllomedusa burmeisteri* was the most frequently mentioned by men (VU = 0.91); however, amongst all residents, this species presented a VU of 0.65 (Figure 3). We did not have enough data from children to assess whether their knowledge was significantly different from women or not, but both women and children were clearly separated from men's knowledge on amphibians.

All interviewees showed partial or complete knowledge of the species shown on the board. The group is generically known as "sapos" (toads). Interviewees were

able to separate the species using their shapes, colours and habitats into inclusive groups, showing traces of a Berlinean classification reaching a "species" level at some points. For example, two main groups within the Order Anura were distinguished: "rãs" (frogs, in Portuguese) grouping families Hylidae and Leptodactylidae (commonly known as tree-frogs) and "sapos" (toads, in Portuguese), corresponding to Bufonidae (Frost 2019). "Rãs" were divided in "rã cinzenta" (grey frog in Portuguese), identified as the largest one and corresponding to the genus *Boanas* and "rã verde" (green frog in Portuguese) as those living on leaves and belonging to the genus *Phyllomedusa*. Within Bufonidae, the folk classification did not distinguish between species n° 3 and 4, grouping them as "sapos molinhos e chatos" (soft and squishy toads). During the interviews, many popular names were mentioned by the residents. The only member of Order Gymnophiona, the caecilian *Siphonops* sp. was systematically separated from the Anura and received the largest number of folk names (Table 2).

In addition to the systematic recognition, we also analysed the popular sayings related to the amphibians shown in the questionnaire. All of the identified myths correspond to the generic group "sapos" (toads), the most common being that "every toad drops milk that can blind someone if it touches the eyes" and "if you catch a

Table 2. Popular names and habitats given to amphibians by residents of the surroundings of a protected area in the Atlantic Forest, north-eastern Brazil. **ID** *: Identification number of the species on Figure 2; F2**: Number of times when each common name was mentioned or no name was given.

Scientific name	Common name	ID *	F2**	Habitat
Anura				
Leptodactylidae				
Leptodactylus latrans	Gia	**1**	13	Water
	Caçote	–	6	Ponds
	Cururu	–	1	Wetlands
	Rã	–	1	Rivers
	No name	–	8	–
Physalaemus camacan	–	**5**	–	–
	No name		5	–
Physalaemus cf. *camacan*	Perereca	**6**	1	–
	No name	–	2	–
Hylidae				
Boana faber	Rã	**2**	17	Trees
	Perereca	–	1	Bromeliads
	Rã cinzenta	–	1	Leaves
	No name	–	3	–
Phyllomedusa burmeisteri	Rã	**17**	17	comes with the flood
	Perereca	–	1	Trees
	Rã verde	–	3	Cocoa
	Gia	–	2	Leaves, branches
	No name	–	3	–
Dendropsophus elegans	Rã	**7**	3	–
Microhylidae				
Stereocyclops incrassatus	Sapinho mole	**3**	1	–
	No name	–	6	–

Scientific name	Common name	ID *	F2**	Habitat
Bufonidae				
Pipa carvalhoi	–	**4**	–	–
	No name	–	3	–
Frostius erythrophthalmus		**8**	–	–
	No name	–	1	–
Rhinella granulosa	Sapo	**11**	4	Holes
	Cururu	–	2	–
	Gia	–	1	–
	Sapo-boi	–	1	–
	No name	–	13	–
Rhinella hoogmoedi	–	**12**	–	–
	No name	–	5	–
Rinella crucifer	Sapo cururu	**16**	4	–
	Sapo	–	1	–
	No name	–	6	–
Ceratobatrachidae				
Phyllodytes melanomystax	Rã	**9**	1	–
	Gia	–	1	–
	No name	–	2	–
Aromobatidae				
Allobates olfersioides	Perereca	**10**	1	–
	No name	–	3	–
Craugastoridae				
Haddadus binotatus	Gia	**13**	1	Clean water
	Caçote	–	1	–
	No name	–	2	–
Odontophrynidae				
Proceratophrys renalis	Sapo-boi	**15**	17	Cocoa leaf litter
	Minisapo-boi	–	1	–
Gymnophiona				
Dermophiidae				
Siphonops sp.	Cobra-de-duas-cabeças	**14**	8	–
	Cobra do chão	–	2	–
	Cecília	–	1	–
	Iscaçú	–	1	–
	Iscuçú	–	1	–
	Muçum	–	1	–
	cobra-preta	–	1	–
	Cobra-cega	–	1	–
	No name	–	4	–

toad with your hand, you get shingles" which leads to the situation that the majority of respondents have avoided touching them. However, no specific myth or tale was identified for any given species.

Four of the nine categories described by Kellert (1993) (Table 1) were identified: symbolic, moralistic, utilitarian and negativistic (Table 3) and when asked where they had heard such comments, the answer was unanimous: everyone said that they heard them from the older people with some mentioning also neighbours or parents.

Table 3. Phrases or behaviour regarding the anurans in the photos, by residents of the surroundings of a protected area in the Atlantic Forest, north-eastern Brazil. F1* = Number of times the reaction or comment was made; ** classification in biophillic categories according to Kellert (1993).

ID*	Comments	Classification**
10	People showed disgust while looking at the photos on the board	Negativistic
6	Unleashes a milk or pees and, if this liquid reaches the eyes, it blinds	Negativistic
4	Has "milk", if thrown at a person, it gives shingles	Negativistic
1	"If you walk on the eggs, you get chilblains"	Negativistic
1	"Pees on someone and the spot itches"	Negativistic
1	"Toads are poisonous"	Negativistic
7	"Killing means bad luck, they feed on insects"	Moralistic
3	"If you put someone's name in the mouth of a toad and sow it, the person gets ill"	Moralistic
1	"If it appears, it means rain"	Moralistic
1	"If a guy kills a toad when he is building a house and the dead toad stays there (at the construction site), the house owner dies"	Moralistic
1	"If you want to get married, you have to unravel the mouth of a toad and you can't let him die"	Moralistic
2	"Those who kill toads don't raise chickens"	Symbolic
9	"You can eat "gia", but I don't know which one it is" (sp. N° 1 *Leptodactylus latrans*)	Utilitarian
3	"Cut a piece of the skin, roast it, grind it and put the powder on a wound (gangrene or diabetes), while the toads' wound heals so does the persons'" (*Leptodactylus latrans*)	Utilitarian
1	"Cut the belly and take the lard, fry it and take the droplets as a medicine. It's good for fatigue (asthma)"	Utilitarian
1	Spit into its mouth and release it, cures fatigue, asthma.	Utilitarian
1	Serves as a toad vaccine (*Phyllomedusa burmeisteri*)	Utilitarian
1	"Put it in cachaça to preserve it"	Utilitarian

Discussion

Traditionally, scholars have attempted to understand the principles underlying ethnoclassifications, including different ways of organising categories of living things in the natural world. Does classification serve cognitive or utilitarian ends, a mix of both or neither? (Dwyer 2005). The ethnobiological information collected throughout this study allowed the identification of a somehow distant relationship of the residents with amphibians, despite the registration of a certain level of ecological awareness, evident when residents declared not killing frogs because they eat bugs or are associated with bad luck. A similar attitude (not killing frogs because they are good for the environment) was registered for residents neighbouring the Adolpho Ducke reserve, in Manaus (AM), northern Brazil by Pontes da Silva et al. (2016), although their study differs from ours in showing a strongly negative perception of frogs. Ceríaco (2012) states that amphibians are valued less negatively than reptiles in Portugal. We cannot assess this statement with our current data, but our perception is that the mildly negative attitude towards amphibians shown in this study could be contrasted with a strongly negative attitude towards reptiles, especially snakes. Although the people from Una understand, to a certain point, the ecological function and importance of amphibians, even assuming a significant ethic position of not killing them, they rarely mentioned information on myths and did not have a clear identification for most species. The population of Una classifies the group

generically as "sapos" (toads) and "rãs" (frogs) and characteristics such as colour, shape and patterns have been used to separate some of the different species.

During our interviews, the use of a Berlinean classification system by the residents of the REVIS was evident. According to Berlin (1992), the way that humans see and classify the world or interact with available natural resources even exploring them economically, seems to be common to all societies and cultures. The forms and grades of classification differ between regions, but some features are commonly shared and therefore similar to those used by taxonomists to group living beings (Berlin 1973). Berlin (1992) defends the premise that human minds are inclined to recognise 'natural discontinuities' in plant and animal domains, whereby ambient flora and fauna are recognised, named and classified according to easily perceptible morphological cues. The Berlinean system has been interpreted as largely functional and utilitarian in construction and design, however, predicated on the culturally-constructed "use value" attached to living things (Hunn 1982). Our data indicate that men seem to have more knowledge on potential uses for amphibians than women. This seems plausible because men (as mentioned by themselves) have more frequent contact with their natural surroundings in low-income rural societies in the region, as they have to walk to their working places every day, when they need to deal with the forest tasks, whereas women and children mostly pass their days near their homes due to domestic affairs (Castilho et al. 2013). Despite this, both groups mentioned almost the same species.

Although interviewees contemplated almost all species shown in the photos, two of them, *Leptodactylus latrans* (Leptodactylidae) and *Phyllomedusa burmeisteri* (Hylidae), were consistently identified and used for food (the former) and medicine (the latter). Although open ponds are the preferred habitat for both species, *P. burmeisteri* is arboreal and commonly found in scrub vegetation, preferring ponds surrounded by vegetation, while *L. latrans* lives on the ground and shows more vagility (Portela and Santos 2016). Therefore, it makes sense that people, who are not in constant movement to and from the forest, encounter *L. latrans* more often, since the frog itself moves more and it lives well in man-disturbed habitats. All men interviewed are frequently shifting from one place to another and transiting throughout the forest more than women, as has already been reported elsewhere (Castilho et al. 2013), thereby increasing the probability of observing species with a smaller home range, such as *P. burmeisteri*. Fernandes-Ferreira et al. (2013) also identified two species used for these purposes by a community from the same region: *Leptodactylus vastus* (Leptodactylidae) for food, which happened to be the genus reported for this same use in the present study and *Rhinella jimi* (Bufonidae). Amphibians are also used for food and medicine in cultures from distant parts of the world, such as the Nepalese (Shrestha and Shah 2017). Traditional Indonesian tribes also eat some frogs, but not as a preferred food item (Ellen et al. 1976).

Due to the significant amphibian diversity known for the Atlantic Forest of southern Bahia, specifically in Cacao – Cabruca systems (Silvano and Pimenta 2003), such as the REVIS-Una (Sambuichi et al. 2012), we expected a list of used species and a more complex relationship of the community with them. Although only two species were

classified as utilitarian, all species shown were mentioned at least once by the respondents, meaning that the 17 different species have already been observed by the community of the REVIS Una. It is important to note that, although there is a perception of high amphibian diversity, people´s knowledge about the biology and ecological importance of amphibians still seems superficial and any comment was merely described as a statement from ancestors or neighbours. The one consistent fact amongst all interviewees was that they do not interact with amphibians for fear of being burnt or having bad luck. There is also an aesthetic factor to consider, for it has been shown elsewhere that aesthetics is an important determinant of public support for species protection (Knight 2008). In our study, we did not examine this aesthetics factor, but we revealed mildly negative values towards amphibians. Kellert (1993) states that a negative value is indicated when people show feelings of fear, aversion and dislike for some species of animals. We argue that some part of these negative values could be based on aesthetic arguments, so when exploring the negative values, we may also be exploring aesthetics.

Beliefs often serve as a frame of reference for our lives. Although they can be changed, it often takes time or strong evidence to persuade someone to do so and these are considered deeply rooted in our cultural and family world perspective. Values are core concepts and ideas of what we consider good or bad, right or wrong or what is worth the sacrifice. Attitudes are how we conduct our everyday life and are based on beliefs and values (McLean 2003). Ancestral discourses shape beliefs and values and have an impact towards people's attitudes towards frogs and toads. When concerning health issues, for example, such as the possibility of poisoning by touching a toad, all interviewees learned from their elders that toads allegedly release a certain dangerous substance at the slightest touch and, therefore, nobody touches them or gets close to the animals. Attitudes and views of reptiles and amphibians are influenced by negativistic values and folk knowledge, with a sociodemographic factor also playing an important role in the understanding of these feelings and attitudes (Ellen et al. 1976; Ceríaco 2012). Rural people, such as out interviewees, have traditionally little access to formal education and therefore traditional knowledge and myths about animals can be perpetuated and assumed as truth, due to a lack of scientific information. Toads (genus *Bufo*) do secrete a creamy substance from their parotid glands, this being considered a protection mechanism against predators, for they lack spines, nails or sharp teeth as protective tools. This substance has an increased toxicity when in contact with oral mucosa of mammals, being able to severely poison or even kill dogs or other mammals of small size (Sakate et al. 2000). Although some Neotropical toads are known to shoot poison from their parotid gland (Toledo et al. 1992; Jared et al. 2009), there is no report of human poisoning or death by toad secretions from any of the species from southern Bahia. More environmental education and demystification by NGOs or academic-orientated groups are needed, because killing or hunting frogs and toads is still common, simply because of fear and a lack of information on actual risks.

Our study registered some aspects of local ecological knowledge regarding amphibians that have consistency with reported literature and which prevents the community from killing the amphibians that they see. For example, the potential to affect wound healing, reported by our interviewees, has been suggested elsewhere

(Toledo and Jared 1989). Those toxins are produced to grant the toads protection against predators or skin infections and local community should be made aware of this information, to diminish their fear for these gentle animals. Myths, sayings and beliefs and the relationship between humans and amphibians were classified according to Kellert's (1993) categories for biophilic values. Symbolic values arise in the form of metaphors, such as in the popular saying: "Those who kill toads don't raise chickens", meaning the same as the direct belief that "Killing toads leads to bad luck", which was classified as amoralistic/spiritual. There are also negativistic attitudes, revealed when respondents show disgust or repulsion when looking at the amphibian images shown for this study. The identification of these statements is crucial to understand the co-existence of this community with the amphibian fauna and consequently serve as support for future interventions through institutions engaged with improving the quality of life for the residents of this protected area.

It is worth mentioning that sayings and reflections on the amphibian role within the community's vision of nature came from the "elders", who are represented by (mostly but not exclusively) men carrying a knowledge that might or might not have scientific correspondence. Such knowledge was brought to them by their ancestors, who in turn may or may not have had access to systematic knowledge and creating some type of "myth" which ends up not being questioned. To update the community's knowledge, therefore demystifying amphibians and creating a healthy relationship with this group, any approach must consider these elders and the respect they inspire in their surroundings. Appreciation for the knowledge of the elder goes hand in hand with respect for the local culture. Environments, where younger generations respect the knowledge of the elder, have lesser degrees of family conflicts and even generate prejudice towards the rural environment.

A crucial issue in the development and implementation of conservation strategies is the appropriate dialogue with local communities. The lack of dialogue and enforcement of management rules, without a mutual understanding, leads to conflicts, which may reflect in ineffective management and may even lead to opposite effects (Lopes et al. 2010). Ethnobiological studies are necessary to better understand the relationship between communities and natural resources and consequently improve the dialogue between all actors involved in their progress, as well as in biodiversity conservation. Migration, resettlement and economic change are likely combined in this region (Johns 1999; Walker 2007) and this surely alters the cultural significance of amphibians and many other species in southern Bahia. Ethnobiological research can provide subsidies for managers and decision-makers to deal with these kinds of dialogues (Cardozo et al. 2018).

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References

Aguiar AP, Chiarello AG, Mendes SL, Matos ED (2003) The Central and Serra do Mar Corridors in the Brazilian Atlantic Forest. The Atlantic Forest of South America: Biodiversity Status, Threats and Outlook Center for Applied Biodiversity Science at Conservation International. Island Press, Washington, 118–132.

Alves RRN (2012) Relationships between fauna and people and the role of ethnozoology in animal conservation. Ethnobiology and Conservation 1(2): 1–69. https://doi.org/10.15451/ec2012-8-1.2-1-69

Aona LY, Faden RB, Bittrich V, Maria do Carmo EA (2016) Four new species of Dichorisandra (Commelinaceae) endemic from Bahia State, Brazil. Brittonia 68(1): 61–73. https://doi.org/10.1007/s12228-015-9397-x

Begossi A, Castro F, Silvano R (2004) Ecologia humana e conservação. Ecologia de pescadores da Mata Atlântica e da Amazônia. São Paulo, 313–324.

Berkes F (2004) Rethinking community-based conservation. Conservation Biology 18(3): 621–630. https://doi.org/10.1111/j.1523-1739.2004.00077.x

Berkes F, Colding J, Folke C (2000) Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications 10(5): 1251–1262. https://doi.org/10.1890/1051-0761(2000)010[1251:ROTEKA]2.0.CO;2

Berlin B (1973) Folk systematics in relation to biological classification and nomenclature. Annual Review of Ecology and Systematics 4(1): 259–271. https://doi.org/10.1146/annurev.es.04.110173.001355

Berlin B (1992) Ethnobiological Classification: Principles of Categorization of Plant and Animals in Traditional Societies. Princeton University Press, Princeton. https://doi.org/10.1515/9781400862597

Braga HO, Schiavetti A (2013) Attitudes and local ecological knowledge of fishermen in relation to conservation and bycatch of sea turtles (reptilian: Testudines), Southern Bahia, Brazil. Journal of Ethnobiology and Ethnomedicine 9(1): 15–27. https://doi.org/10.1186/1746-4269-9-15

Campos FS, Brito D, Solé M (2013) Threatened Amphibians and Their Conservation Status within the Protected Area Network in Northeastern Brazil. Journal of Herpetology 47(2): 277–285. https://doi.org/10.1670/11-158

Campos FS, Trindade-Filho J, Brito D, Llorente GA, Solé M (2014) The efficiency of indicator groups for the conservation of amphibians in the Brazilian Atlantic Forest. Ecology and Evolution 4(12): 2505–2514. https://doi.org/10.1002/ece3.1073

Cardozo, LS, Alarcon, DT, Campiolo S, Schiavetti A (2018) Análise da Governança Ambiental e Percepção sobre Processos Participativos da Reserva Extrativista de Canavieiras, Bahia, Brasil Desenvolvimento e Meio Ambiente, Edição especial. https://doi.org/10.5380/dma.v50i0.58825

Castilho LC, Martinez RA, Giné GA, Ribeiro GC, Schiavetti A (2013) The thin-spined porcupine, *Chaetomys subspinosus* (Rodentia: Erethizontidae), within protected areas in the Atlantic Forest, Brazil: local knowledge and threats. Tropical Conservation Science 6(6): 796–810. https://doi.org/10.1177/194008291300600607

Castilho LC, De Vleeschouwer KM, Milner-Gulland EJ, Schiavetti A (2017) Hunting of mammal species in protected areas of the southern Bahian Atlantic Forest, Brazil. Oryx: 1–11. https://doi.org/10.1017/S0030605317001247

Castilho LC, De Vleeschouwer KM, Milner-Gulland EJ, Schiavetti A (2018) Attitudes and Behaviors of Rural Residents Toward Different Motivations for Hunting and Deforestation in Protected Areas of the Northeastern Atlantic Forest, Brazil. Tropical Conservation Science 11: 19–29. https://doi.org/10.1177/1940082917753507

Catenacci L, Nunes-Neto J, Castro FC, Lemos P, Oyama E, Deem SL, Travassos-Da-Rosa E (2017) New records of mosquito species (Diptera: Culicidae) for Bahia (Brazil). International Journal of Mosquito Research 4(4): 12–16. http://patua.iec.gov.br//handle/iec/3694

Ceríaco LMP (2012) Human attitudes towards herpetofauna: The influence of folklore and negative values on the conservation of amphibians and reptiles in Portugal. Journal of Ethnobiology and Ethnomedicine 8(8): 1–12. https://doi.org/10.1186/1746-4269-8-8

Chakravorty J, Meyer-Rochowand VB, Ghosh S (2011) Vertebrates used for medicinal purposes by members of the Nyishi and Galo tribes in Arunachal Pradesh (North-East Indi). Journal of Ethnobiology and Ethnomedicine 7(1): 1–14. https://doi.org/10.1186/1746-4269-7-13

Charnley S, Fischer AP, Jones ET (2008) Traditional and local ecological knowledge about forest biodiversity in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-751. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 52 pp. https://doi.org/10.2737/PNW-GTR-751

Dencker A (1998) Métodos e Técnicas de Pesquisa em Turismo. Futura, São Paulo, 233 pp.

Dias IR, Medeiros TT, Nova MFV, Solé M (2014) Amphibians of Serra Bonita, southern Bahia: A new hotpoint within Brazil's Atlantic Forest hotspot. ZooKeys 449: 105–130. https://doi.org/10.3897/zookeys.449.7494

Diegues AC (2000) Etnoconservação da natureza: Enfoques alternativos. In: Diegues AC (Org.) Etnoconservação: Novos Rumos Para a Proteção da Natureza nos Trópicos. São Paulo, Editora Hucitec/ Napaub – USP, 290 pp.

Dwyer PD (2005) Ethnoclassification, ethnoecology and the imagination. Journal de la Société des Oceanistes 120–121: 10–25. https://doi.org/10.4000/jso.321

Ellen R, Harris H (2000) Introduction: indigenous environmental knowledge and its transformations. Indigenous environmental knowledge and its transformations: critical anthropological perspectives. Studies in environmental anthropology. Harwood Academic Publishers, Amsterdam, 34 pp.

Ellen RF, Stimson AF, Menzies J (1976) Structure and inconsistency in Nuaulu categories for amphibians. Journal d'Agriculture Tropicale et de Botanique Appliquee 23(7–12): 125–138. https://doi.org/10.3406/jatba.1976.3245

Fernandes-Ferreira H, Mendonca SV, Cruz RL, Borges-Nojosa DM, Alves RRN (2013) Hunting of herpetofauna in montane, coastal, and dryland areas of Northeastern Brazil. Herpetological Conservation and Biology 8(3): 652–666.

Frost DR (2019). Amphibian Species of the World: an Online Reference. (Version 5.3). American Museum of Natural History, New York. http://research.amnh.org/vz/herpetology/amphibia/

Garcia PO, Lobo PC (2007) Metodologias para Levantamentos da Biodiversidade Brasileira. Universidade Federal de Juiz de Fora. http://www.ecologia.ufjf.br/admin/upload/File/Paulo_Garcia.pdf. 14–18

Gardner TA, Barlow J, Peres CA (2007) Paradox, presumption and pitfalls in conservation biology: The importance of habitat change for amphibians and reptiles. Biological Conservation 138(1–2): 166–179. https://doi.org/10.1016/j.biocon.2007.04.017

Geertz C (1973). Thick description: Toward an interpretive theory of culture. The Cultural Geography Reader. Routledge, Abindgdon, 41–51.

Gouvêa JBS, Silva LAM, Hori M (1976) Fitogeografia. Diagnóstico sócio-econômico da região cacaueira (Vol. 7): Recursos Florestais. Ceplac, Instituto Interamericano de Ciências Agrícolas, Ilhéus, 17 pp.

Haddad CF, Toledo LF, Prado CP, Loebmann D, Gasparini JL, Sazima I (2013) Guide to the Amphibians of the Atlantic Forest: Diversity and Biology. Editora Anolis Books, São Paulo.

Horwich RH, Lyon J (2007) Community conservation: Practitioners' answer to critics. Oryx 41(3): 373–385. https://doi.org/10.1017/S0030605307001010

Hunn E (1982) The utilitarian factor in folk biological classification. American Anthropologist 84(4): 830–847. https://doi.org/10.1525/aa.1982.84.4.02a00070

IBGE Instituto Brasileiro de Geografia e Estatística (2010) Censo Demográfico. [accessed: March 18 2019]

IUCN (2019) The IUCN Red List of Threatened Species. v 2019-2. http://www.iucnredlist.org [accessed: July 18 2019]

ICMBio (2014) Instituto Chico Mendes. http://www.icmbio.gov.br/portal/udeconservacao/biomas-brasileiros/mata-atlantica/unidades-de-conservacao-mata-atlantica/2138-revis-de-una [accessed: August 13th, 2018]

Jared C, Antoniazzi MM, Jordao AE, Silva JR, Greven H, Rodrigues MT (2009) Parotoid macroglands in toad (*Rhinella jimi*): Their structure and functioning in passive defence. Toxicon 54(3): 197–207. https://doi.org/10.1016/j.toxicon.2009.03.029

Johns N (1999) Conservation in Brazil's Chocolate Forest: The Unlikely Persistence of the Traditional Cocoa Agroecosystem. Environmental Management 23(1): 31–47. https://doi.org/10.1007/s002679900166

Kellert SR (1993) The biological basis for human values of nature. In: Kellert SR, Wilson EO (Eds) (1998) The biophilia Hypothesis. Island Press, Washington, 42–69.

Knight AJ (2008) "Bats, snakes and spiders, Oh my!" How aesthetic and negativistic attitudes, and other concepts predict support for species protection. Journal of Environmental Psychology 28(1): 94–103. https://doi.org/10.1016/j.jenvp.2007.10.001

Lopes P, Silvano R, Begossi A (2010) Da Biologia a Etnobiologia-Taxonomia e etnotaxonomia, ecologia e etnoecologia. In: Alves RNN, Souto WMS, Mourão JJ (Eds) A Etnozoologia no Brasil: importância, Status Atual e Perspectivas. NUPEEA, 69–94.

Lourenço-de-Moraes R, Solé M, Toledo LF (2012) A new species of *Adelophryne* Hoogmoed and Lescure 1984 (Amphibia: Anura: Eleutherodactylidae) from the Atlantic rainforest of southern Bahia, Brazil. Zootaxa 3441(1): 59–68. https://doi.org/10.11646/zootaxa.3441.1.6

Lourenço-de-Moraes R, Dias IR, Mira-Mendes CV, De Oliveira RM, Barth A, Ruas DS, Vences M, Solé m, Bastos RP (2018) Diversity of miniaturized frogs of the genus *Adelophryne* (Anura: Eleutherodactylidae): A new species from the Atlantic Forest of northeast Brazil. PLoS ONE 13(9): e0201781. https://doi.org/10.1371/journal.pone.0201781

Marques JGW (1991) Aspectos Ecológicos na Ecologia dos Pescadores do Complexo Estuarino – Lagunar de Mundaú – Manguaba, Alagoas – Tese (Doutorado). UNICAMP, São Paulo, 292 pp.

Marques JGW (2001) Pescando Pescadores. Ciência e Etnociência em uma Perspectiva Ecológica (2nd edn.). NUPAUB-USP, São Paulo.

McLean S (2003) The Basics of Speech Communication. Allyn and Bacon Eds., Boston, 289 pp.

Menezes JA, Carmo-Neto D (1993) A modernização do agribusiness cacau. Fundação Cargill, Campinas, 223 pp. www.worldcat.org/title/modernizacao-do-agribusiness-cacau/oclc/709339472

Mittermeier RA, Hoffmann FM, Pilgrim J, Brooks T, Gil PR, Mittermeier C, Lamoreux J (2005) Hotspots Revisitados-As Regiões Biologicamente Mais Ricas e Ameaçadas do Planeta. Mata Atlântica e Cerrado, Internacional Conservation.

Phillips O, Gentry AH, Reynel C, Wilkin P, Gálvez-Durand BC (1994) Quantitative ethnobotany and Amazonian conservation. Conservation Biology 8(1): 225–248. https://doi.org/10.1046/j.1523-1739.1994.08010225.x

Pontes-Da-Silva E, Tinoco MLP, Pequeno PAC, Franklin E, Kaefer IL (2016) Attitudes towards scorpions and frogs: A survey among teachers and students from schools in the vicinity of an amazonian protected area. Journal of Ethnobiology 36(2): 395–411. https://doi.org/10.2993/0278-0771-36.2.395

Portela L, Santos T (2016) *Leptodactylus latrans* (Criolla Frog) diet. Herpetological Review 47(4): 1–642.

Recoder RS, Teixeira JR, Cassimiro J, Camacho A, Rodrigues MT (2010) A new species of *Dendrophryniscus* (Amphibia, Anura, Bufonidae) from the Atlantic rainforest of southern Bahia, Brazil. Zootaxa 2642(1): 36–44. https://doi.org/10.11646/zootaxa.2642.1.3

Ribeiro MC, Metzger JP, Martensen AC, Ponzoni FJ, Hirota MM (2009) The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. Biological Conservation 142(6): 1141–1153. https://doi.org/10.1016/j.biocon.2009.02.021

Sakate M, Oliveira P, Lucas D (2000) Toad envenoming in dogs: Effects and treatment. The Journal of Venomous Animals and Toxins 6(1): 52–62. https://doi.org/10.1590/S0104-79302000000100003

Sambuichi RH, Vidal DB, Piasentin FB, Jardim JG, Viana TG, Menezes AA, Baligar VC (2012) Cabruca agroforests in southern Bahia, Brazil: Tree component, management practices and tree species conservation. Biodiversity and Conservation 21(4): 1055–1077. https://doi.org/10.1007/s10531-012-0240-3

Shrestha B, Shah KB (2017) Mountain Survey of Amphibians and Reptiles and their Conservation Status in Manaslu Conservation Area, Gorkha District, Western Nepal. Conservation Science 5(1): 13–18. https://doi.org/10.3126/cs.v5i1.24297

Silvano DL, Pimenta BVS (2003) Diversidade e distribuição de anfíbios na Mata Atlântica do Sul da Bahia. In: Prado PI, Landau EC, Moura RT, Pinto LPS, Fonseca GAB, Alger K (Eds) Corredor de Biodiversidade na Mata Atlântica do Sul da Bahia CD-ROM, Ilhéus, IESB/CI/CABS/UFMG/UNICAMP

Solberg I, Schiavetti A, Bruck-Moraes ME (2014) Manejo agrícola no refúgio de vida silvestre de una: Agroflorestas como uma perspectiva de conservação. Revista Árvore 38(2): 241–250. https://doi.org/10.1590/S0100-67622014000200004

Tabarelli M, Pinto LP, Silva JM, Hirota M, Bede L (2005) Challenges and opportunities for biodiversity conservation in the Brazilian Atlantic Forest. Conservation Biology 19(3): 695–700. https://doi.org/10.1111/j.1523-1739.2005.00694.x

Toledo RC, Jared C (1989) Considerações sobre o veneno dos anfibios. Ciencia e Cultura 41(3): 250–258.

Toledo RC, Jared C, Brunner A (1992) Morphology of the large granular alveoli of toad (*Bufo ictericus*) paratoid glands before and after compression. Toxicon 30(7): 745–753. https://doi.org/10.1016/0041-0101(92)90008-S

Vörös J, Dias IR, Solé M (2017) A new species of *Phyllodytes* (Anura: Hylidae) from the Atlantic Rainforest of southern Bahia, Brazil. Zootaxa 4337(4): 584–594. https://doi.org/10.11646/zootaxa.4337.4.9

Walker T (2007) Slave Labor and Chocolate in Brazil: The Culture of Cacao Plantations in Amazonia and Bahia (17th–19th Centuries). Food & Foodways 15(1–2): 75–106. https://doi.org/10.1080/07409710701260214